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Accuracy of prognostic scores in decision making and predicting outcomes in metastatic spine disease

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ABSTRACT

INTRODUCTION Management of metastatic spinal disease has changed significantly over the last few years. Different prognostic scores are used in clinical practice for predicting survival. The aim of this study was to assess the accuracy of prognostic scores and the role of delayed presentation in predicting the outcome in patients with metastatic spine disease.

METHODS Retrospectively, four years of data were collected (2007–2010). Medical records review included type of tumour, duration of symptoms, expected survival and functional status. The Karnofsky performance score was used for functional assessment. Modified Tokuhashi and Tomita scores were used for survival prediction.

RESULTS A total of 55 patients who underwent surgical stabilisation were reviewed. The mean age was 63 years (range: 32–87 years). The main primary sources of tumours included myeloma, breast cancer, lymphoma, lung cancer, renal cell cancer and prostate cancer. Of the cases studied, 29 patients had posterior instrumented stabilisation alone, 10 patients had an anterior procedure alone and 16 patients (with an expected survival of more than one year) had both anterior and posterior procedures performed. Twenty-three patients presented with spinal cord compression. The mean follow-up duration was 9 months (range: 1–39 months). Patients who were treated within one week of referral survived longer than anticipated. Patients were divided into three groups based on their expected survival. Actual survival was better in all three groups after surgery. Discrepancies in scores were prominent in patients with myeloma, breast and prostate cancers. Functional outcome was better in patients under 65 years of age.

CONCLUSIONS The prognostic scoring systems are not uniformly effective in all types of primary tumours. However, they are useful in decision making for surgical intervention, taking other factors into account, in particular the age of the patient, the type and stage of the primary tumour and general health.

KEYWORDS

Metastatic cord compression – Metastatic spine disease – Prognostic scores – Spinal decompression and stabilisation – Spinal tumours

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Management of metastatic spinal disease has changed significantly over the last few years. The use of recent advances in spinal instrumentation in conjunction with surgical decompression of the metastatic lesion has resulted in significant improvement in the outcome. Recently evolved minimally invasive vertebral body cement augmentation techniques such as vertebroplasty and kyphoplasty are useful in managing osteolytic spinal secondary induced pain and also reduce the need for anterior spinal reconstruction.

Pain arising from metastatic spine disease can be severe enough to cause significant disability in performing daily activities and mobilisation. Significant bone destruction can lead to fracture, instability and deformity. Spinal cord compression may result from pathological fractures or direct invasion by the tumour.[1–4] Surgery helps to alleviate pain, preserve or improve neurological function, achieve mechanical stability, optimise local tumour control and improve the quality of life. However, the method of treatment for individual patients is not easy to choose. The decision for definitive treatment should be influenced strongly by the predicted survival. Before making the final decision for definitive surgery, multiple other factors must be considered including general health, nutrition, aggressiveness of the primary tumour and extent of preoperative neurological deficit.[5–7]

Different prognostic scores are used in clinical practice for predicting survival of these patients. One of the commonly used is the modified Tokuhashi score (MTS),[8] accord-

ing to which, the higher the score, the better the prognosis and hence more aggressive intervention is indicated. In the Tomita scoring system,[9] the lower the score, the better the prognosis, indicating more aggressive treatment. Prior to the start of our study, it was noticed in our clinical practice that some of the patients with low modified Tokuhashi and high Tomita scores, who were expected to have poor outcomes from surgical intervention, underwent surgery mainly for palliative reasons. It was found subsequently that the outcome for these patients was better than anticipated. It was therefore suspected that these prognostic scores may not be uniformly effective in all types of malignancies.

Methods

We performed a retrospective review over a period of four years (2007–2010) of the patients with suspected or definitive spinal metastases and metastatic spinal cord compression. Medical record review included demographic data, type of primary tumour, duration of symptoms, location of metastases, disability status, assessment of expected and actual survival, treatment method used, functional outcome and postoperative complications. We used the Karnofsky performance score (Table 1)[10] to assess the patients' functional activity and disability status. This was based on their clinical review preoperatively and 6–8 weeks postoperatively. Modified Tokuhashi (Table 2) and Tomita scores (Table 3) were used to assess the expected survival.

All patients had surgical stabilisation performed by three senior consultant spinal surgeons. This included stabilisation using a posterior approach, an anterior approach or both, either as a single-stage or two-stage procedure. Patients who had biopsy of vertebral body alone or cement augmentation without stabilisation were not included. The preoperative workup included magnetic resonance imaging (MRI) of the whole spine, staging computed tomography (CT) of the chest, abdomen and pelvis, a bone scan or skeletal survey, routine blood parameters and tumour markers if indicated. Postoperatively, patients were allowed to mobilise fully within limits of pain, initially with the help of walking aids and assistance of physiotherapy staff. Patients were followed up regularly at 2 weeks, 6 weeks, 6 months and 12 months depending on their survival. Their management

Table 1 Karnofsky performance score

Description	Score
Normal; no complaints; no evidence of disease	100%
Able to carry on normal activity; minor signs or symptoms of disease	90%
Normal activity with effort; some signs or symptoms of disease	80%
Cares for self; unable to carry on normal activity or do work	70%
Requires occasional assistance but is able to care for most personal needs	60%
Requires considerable assistance and frequent medical care	50%
Disabled; requires special care and assistance	40%
Severely disabled; hospitalisation indicated although death not imminent	30%
Very sick; hospitalisation necessary; requires active support treatment	20%
Moribund; fatal processes progressing rapidly	10%
Dead	0%

Table 2 Modified Tokuhashi Score

Variable	Score
General condition (Karnofsky's performance status)	
Poor (PS 10–40%)	0
Moderate (PS 50%–70%)	1
Good (PS 80%–100%)	2
No. of extraspinal bone metastases foci	
≥3	0
1–2	1
0	2
No. of metastases in the vertebral body	
≥3	0
1–2	1
0	2
Metastases to the major internal organs	
Unremovable	0
Removable	1
No metastases	2
Primary site of the cancer	
Lung, stomach	0
Kidney, liver, uterus	1
Other, unidentified	
Thyroid, prostate, breast, rectum	2
Spinal cord palsy	
Complete	0
Incomplete	1
None	2

Table 3 Tomita Score

Scoring System				Prognostic Score	Treatment Goal	Surgical Strategy
Point	Prognostic factors: Primary tumor	Visceral mets.*	Bone mets.**			
1	slow growth (breast, thyroid, etc.)		solitary or isolated	2	Long-term local control	Wide or Marginal excision
				3		
2	moderate growth (kidney, uterus, etc.)	treatable	multiple	4	Middle-term local control	Marginal or Intralesional excision
				5		
4	rapid growth (lung, stomach, etc.)	un-treatable		6	Short-term palliation	Palliative surgery
				7		
				8	Terminal care	Supportive care
				9		
				10		

* No visceral mets. = 0 point. ** Bone mets. including spinal mets.

also included adjuvant medical treatments (radiotherapy, chemotherapy, hormonal therapy) using a multidisciplinary approach.

Results

We reviewed 55 patients (27 men, 28 women). The mean age was 63 years (range: 32–87 years). The most frequent metastatic lesions were found to be present in the thoracic spine (n=24) followed by the lumbar spine (n=10) and cervical spine (n=8) or at multiple levels (n=13). Primary tumours included myeloma (n=11), breast cancer (n=9), lymphoma (n=8), lung cancer (n=7), renal cell cancer (n=7), prostate cancer (n=5), bladder cancer (n=3), melanoma (n=1), pancreatic cancer (n=1), oesophageal cancer (n=1), endometrial cancer (n=1) and carcinoma of the tongue (n=1) (Fig 1). Twenty-nine patients had posterior instrumented stabilisation alone, ten had anterior stabilisation alone and sixteen patients with an expected survival of more than one year had both anterior and posterior procedures performed in two stages (Fig 2). Twenty-three patients presented with spinal cord compression.

The mean follow-up duration was 9 months (range: 1–39 months). Overall, 39 patients received radiotherapy (6 preoperatively, 33 postoperatively) while 42 received chemotherapy (9 preoperatively, 33 postoperatively). No major surgical complications were seen postoperatively although eight patients developed superficial wound infections, all of whom had received preoperative chemotherapy and/or radiotherapy.

Our patients were divided into three groups based on their Karnofsky score: the red group with scores of <50%, the yellow group with scores of 50–70% and the green group with scores of >70% (Fig 3). In the red group containing 15 patients, 8 patients (53%) achieved independent mobility status (>70%) after surgical stabilisation at 6 weeks, while fewer than half did not improve from their preoperative functional status. In the yellow group containing 20 patients, 13 (66%) achieved independent mobility status (>70%) af-

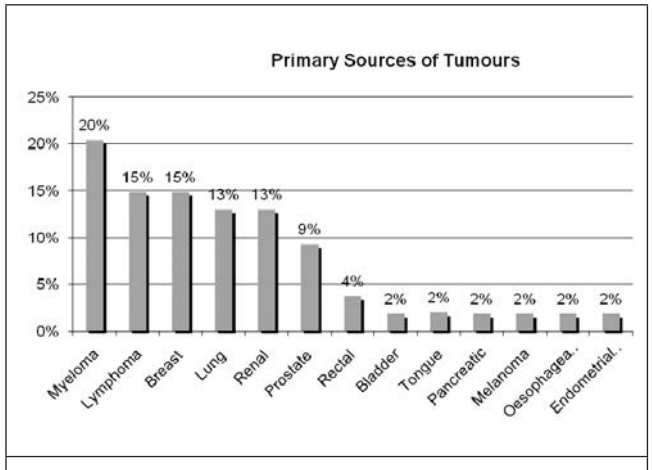

Figure 1 Types of primary tumours

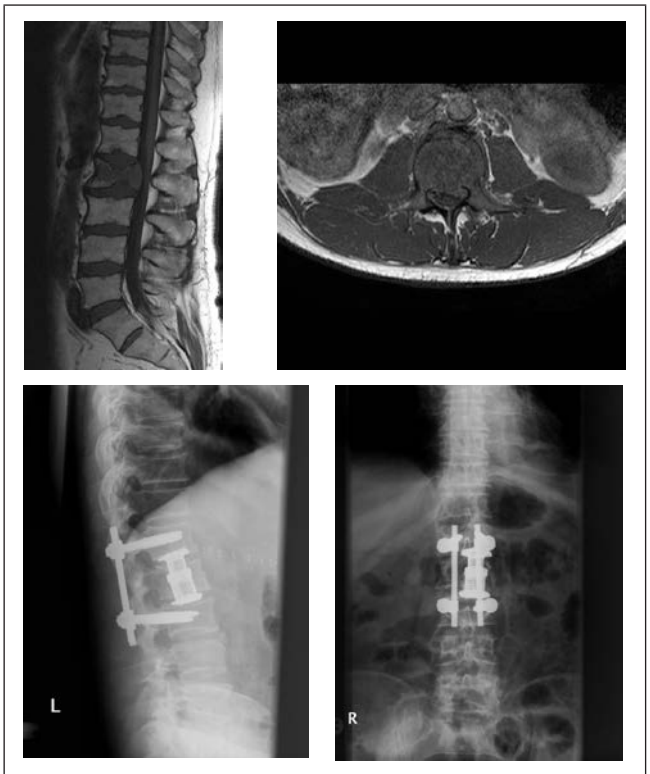

Figure 2 Myeloma in a 57 years male with severe back pain and unable to mobilise with 2 weeks history, treated with 2-stage (posterior stabilization + anterior cage fusion, allograft) had good functional outcome and mobility status

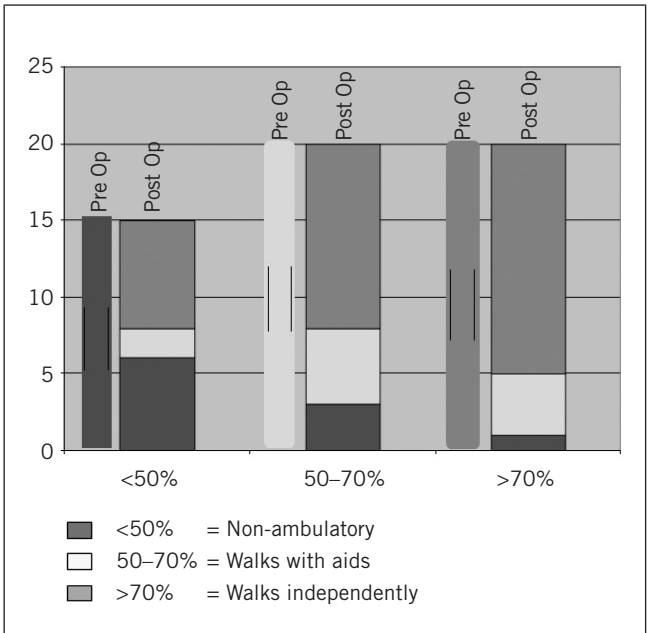

Figure 3 Karnofsky performance score in our patients

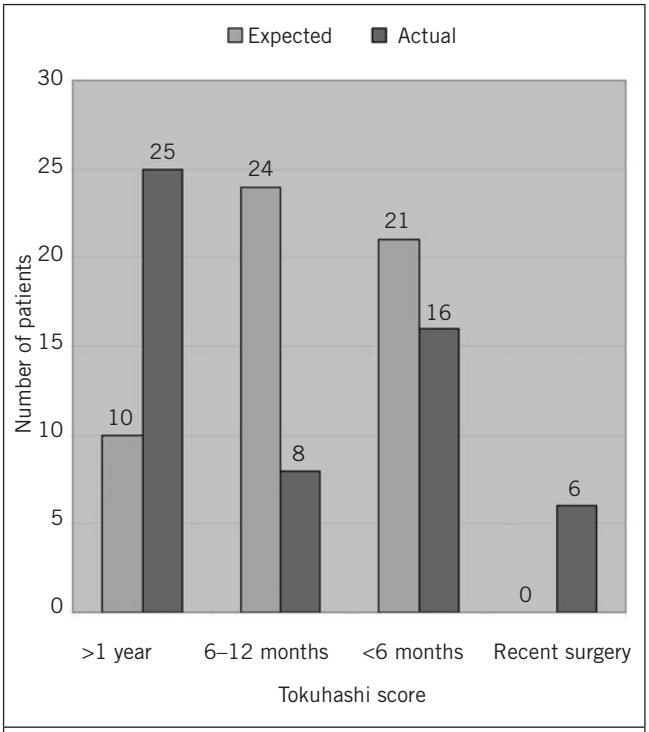

Figure 4 Modified Tokuhashi score in our patients

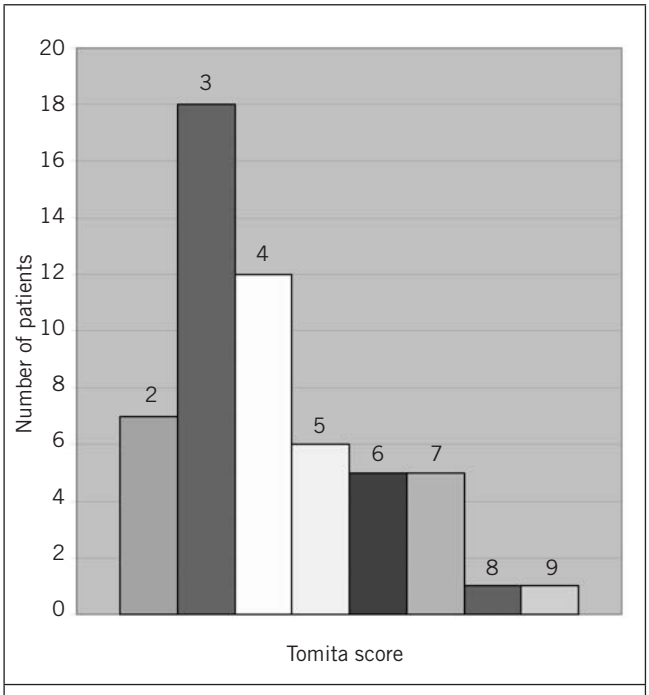

Figure 5 Tomita score in our patients

ter surgery at 6 weeks, 3 (15%) deteriorated due to their progressive tumours and 4 (19%) neither improved nor deteriorated. In the green group with 20 patients, 15 (75%) maintained their independent mobility status while the remaining patients deteriorated due to progressive tumours. A chi-square test for the results in these three groups gave a p-value of 0.4, indicating that the differences were not statistically significant.

Among the patients who were under 65 years of age (n=30), 10 patients (30%) had independent mobility status at the time of presentation. Six weeks after surgical stabilisation, 21 (70%) improved to independent mobility status. Among the patients who were over 65 years of age (n=25), 11 (44%) were able to mobilise independently before surgery while 14 (56%) achieved independent mobility status at 6 weeks after surgery. The p-value calculated by the chi-square test was 0.28, again indicating that there were no statistically significant differences between the two age groups.

Assessment of expected survival was based on the modified Tokuhashi score (Fig 4). The patients were divided into three groups. Group A included 18 patients with an expected survival of <6 months. After surgical stabilisation, the mean actual survival in this group was 8 months (range: 3 weeks – 28 months). Twelve patients died with a mean survival of 5.1 months. Group B consisted of 21 patients with an expected survival of 6–12 months. After surgery their mean actual survival was 18.7 months (range: 3–49 months). In this group, 6 patients died with a mean survival of 17 months. Group C comprised 10 patients with an expected survival of >12 months who had a mean actual survival of 26 months (range: 14–40 months) after surgery. Only 2 patients died in this group with a mean survival of 19.5 months. Six patients had undergone recent surgery (within the previous six months) and therefore required a longer follow-up period for assessment of their outcome.

Assessment of the Tomita score showed 43 patients with scores of 5 or less (range: 2–5), indicating good functional outcome. Twelve patients with scores of 6 or above (range: 6–9) had poor expected outcome but were treated surgically to give them the best possible chances of a better outcome. They performed better than anticipated (Fig 5).

Our results showed that patients who were treated within one week of their referral survived significantly longer than anticipated compared to those treated later than the first week after their referrals (p<0.001). In the early treatment group (n=26), 7 patients (26%) had an expected survival of over 12 months based on the scoring systems. However, after surgical stabilisation, 24 patients (93%) actually survived for more than 12 months. In the late treatment group, 5 patients (15%) had been expected to survive more than 12 months. In fact, after surgical stabilisation, 15 patients (53%) survived for longer.

There were some discrepancies between the expected survival estimated on the basis of scoring systems and the actual survival after surgical intervention. This was predominantly noticed in patients with myeloma, prostate and breast cancers. The actual survival was found to be better than anticipated. Survival prediction from these scores was

consistent in patients with other tumours including lymphoma, lung and renal cancers.

There were 30 patients under the age of 65 years. Of these, the expected survival was <6 months for 10 patients, 6–12 months for 13 patients and >12 months for 7 patients. The mean actual survival in these patients after surgical intervention was 19.8 months (range: 1–49 months). There were 25 patients over the age of 65. Of these, the expected survival was <6 months for 11 patients, 6–12 months for 11 patients and >12 months for 3 patients. After surgery the mean actual survival in these patients was 10.1 months (range: 1–26 months).

Discussion

Prior to the 1970s, surgery was considered an overly aggressive treatment for malignant spinal tumours.[11] With improvements in surgical techniques, medical treatment and perioperative care, indications have gradually broadened. In 1970 Martin and Williamson described their indications for surgery as 'documented progressive neurological deficit, an impending pathological fracture, or obtaining a biopsy sample of a lesion of unknown primary origin'.[12] More recently, the concept of surgical stabilisation to provide pain relief and to treat progressive deformity has been introduced and the clinical results have been good.[13,14] Ability to walk is the single most important factor in the decision making process for surgical intervention in patients with cord compression. Findlay[15] and Bach *et al*[16] have reported that 70% of ambulant, 30% of paraperitic and 5% of paraplegic patients maintained ambulant status after surgical treatment. Patchell *et al* reported that 57% with radiotherapy alone and 84% with surgery and radiotherapy together maintained the ambulant status.[17]

Patient age is a poorly validated factor. According to guidelines by the National Institute of Health and Clinical Excellence in the UK, surgical intervention should not be denied based on patient's age.[18] However, Patchell *et al* showed that preservation of mobility status was significantly prolonged in patients under 65 years of age after surgical intervention compared to radiotherapy alone.[17] Despite this, they did not find any difference in the overall outcome of patients above or below 65 years of age. Contrary to that, Chi *et al* found that as age increases, the beneficial effect of surgery diminishes and becomes equivalent to that of radiation therapy alone.[19]

Sioutos *et al* demonstrated that patients who were ambulatory preoperatively and those with only one vertebral involvement, survived statistically longer than patients who were non-ambulatory and with multilevel disease.[6] They also found preoperative neurological status to be highly predictive of survival. However, in their study on 60 patients, Weigel *et al* did not find this to be an important factor.[20]

The goals of treatment should be to maintain or re-establish spinal stability, improve or preserve neurological function, control pain and improve the quality of life and survival. Treatment options may be non-operative or operative. Non-operative treatment includes radiotherapy and chemotherapy, which are indicated in spinal tumours causing pain without neurological deficit. Surgical treatment ranges from wide excision to palliative surgery. Posterior decompression of the neural structures with instrumented stabilisation is commonly performed as palliative surgery if the expected survival is less than a year. After tumour decompression through the posterior approach, the vertebral body can be reinforced with cement to avoid the need for an anterior procedure.

If the expected survival is longer than a year, vertebral body reconstruction is performed using cage and bone graft to provide long-term stability. Primary anterior procedures are commonly performed if the tumour is located in the vertebral body. These cases may require additional posterior pedicle screw stabilisation as a second procedure. Cement augmentation of the vertebral body (vertebroplasty, kyphoplasty) is indicated in mechanical pain resistant to analgesia. These techniques alone are contraindicated in patients with cord compression but could supplement spinal stabilisation, reducing the need for an additional anterior procedure.

Preoperative planning also includes thorough investigations such as plain x-rays, bone scans, MRI and staging CT of the chest, abdomen and pelvis. MRI is the investigation of choice and should be performed within 1 week in cases of suspected spinal metastases or within 24 hours in cases of suspected cord compression.[18] Percutaneous biopsy using either an image intensifier or CT is needed in patients with an unknown primary tumour. Tissue diagnosis and the amount of visceral and skeletal spread will dictate how aggressively these patients have to be treated.

In our study, actual survival after surgical stabilisation was better than estimated survival. This was noticed particularly in patients with myeloma, prostate cancer and breast cancer. Functional assessment revealed that patients with lung and renal tumours did not do well compared to patients with other primary tumours after surgical intervention. Surgical intervention had significant impact on patients' mobility status. After surgery, 50–75% of patients regained or maintained their independent mobility status. Younger patients (<65 years) survived for longer as well as having better mobility status after surgery compared to older patients. Age was therefore an important predicting factor, both for survival and for regaining or maintaining independent mobility status.

Conclusions

The prognostic scoring systems are not uniformly effective in all types of primary tumours. Nevertheless, they are useful in decision making for surgical intervention if taking other factors into account, especially patient age, type and stage of primary tumour and general health. In addition, early surgical intervention was more effective in maintaining or regaining mobility status and it resulted in a better a functional outcome in patients with spinal metastases. Patient age plays an important role in decision making for surgical intervention as it affects the length of survival and functional outcome.

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